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The Bureau of Infrastructure, Transport and Regional Economics estimates of the costs of road congestion in Australian capital cities (\$9.4 billion in 2005 and projected to more than double by 2020) are widely cited. But these projections appear to overstate the problem and provide little, if any, guidance for sound policy development. They are not measures of the net gain from introducing congestion charging. Moreover, such numbers provide no help for evaluating the net benefits of other policies to deal with congestion, such as increasing road capacity. Without efficiency-based cost-benefit analysis of all policies to deal with road congestion, governments run the risk of lowering social welfare.

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The Problem of Road Congestion: The Futility of ‘Avoidable Cost’ Estimates

Mark Harrison¹

Abstract

The Bureau of Infrastructure, Transport and Regional Economics estimates of the costs of road congestion in Australian capital cities (\$9.4 billion in 2005 and projected to more than double by 2020) are widely cited. But these projections appear to overstate the problem and provide little, if any, guidance for sound policy development. They are not measures of the net gain from introducing congestion charging. Moreover, such numbers provide no help for evaluating the net benefits of other policies to deal with congestion, such as increasing road capacity. Without efficiency-based cost–benefit analysis of all policies to deal with road congestion, governments run the risk of lowering social welfare.

Introduction

Attend any conference on congestion pricing (they are a common occurrence) and a speaker will inevitably cite the estimates by the Bureau of Transport and Regional Economics (and its predecessor²) of the ‘avoidable social cost of congestion’, usually accompanied by a homespun story of how long it takes them to drive to work in the morning. The speaker then goes on to say: ‘Something must be done!’ Road builders will usually recommend building more roads, environmentalists recommend more subsidies for public transport, and economists will usually recommend congestion charging. If the speaker is an economist, the call may be accompanied by a lament that economists have been recommending road pricing for 50 years (see Walters 1961) to no avail; road builders will lament the lack of funding for infrastructure; and environmentalists that people prefer to drive.

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² The Bureau is the successor of the Bureau of Transport and Regional Economics. Both entities are referred to here as ‘the Bureau’.

Of what use is it to know that the 'avoidable social cost' from congestion is \$10, or \$20 billion? Although it serves to highlight the fact that congestion is costly, the number provides little, if any, guidance for sound policy development.

The Bureau figures measure the deadweight loss from excessive congestion, and indicate the potential social gain from a costless, perfect road-pricing scheme that results in the optimal level of road use given road capacity. But in practice, road pricing schemes are expensive and imperfect, and will not reap the theoretical benefits the Bureau numbers estimate.

They don't tell you how, and how much, to spend on reducing congestion. Certainly a cost of \$10 billion a year does not mean we should spend \$10 billion a year solving congestion — the net gain would then be zero, at best.

The relevant policy issue is the costs and benefits of feasible policy responses and which has the greatest net benefit. The aggregate figures do not answer that. Should we introduce road charging, increase road capacity or encourage public transport? Projects to reduce congestion need to be evaluated on their merits, on a case-by-case basis, using standard cost-benefit analysis. The key issue is not the estimated cost of congestion, but the returns to the options for reducing congestion. That requires detailed network analysis and calculations regarding the impact of the policy proposals.

The methodology of the Bureau's cost estimates

In 2006 the Council of Australian Governments commissioned the Bureau to examine the current and emerging causes, trends and impacts of urban traffic growth and congestion. The result was 'Estimating urban traffic and congestion cost trends for Australian cities' (BTRE 2007; references to page numbers in the following text refer to this report).

The Bureau estimated the costs of congestion in 2005, for the eight Australian capital cities, in the base case, or 'business as usual' (p.3), to be \$9.4 billion, and projected they would more than double to \$20.4 billion in 2020 (all figures in 2005 dollars). The costs come from extra travel time and travel time variability, increased vehicle operating costs (more fuel consumption) and extra pollution. Over 75 per cent, \$7.1 billion, of these costs are time costs (p.13), and they will be the focus here.

The above figures represent the 'avoidable social costs of congestion' (p.1) — the difference between the optimal level of congestion (at current capacity) and the actual level — or the deadweight loss from excessive congestion. It is, of course,

not efficient to have no congestion or pollution. Like any cost, congestion costs may be worth bearing if the benefits are greater. The relevant issue is whether the costs of extra pollution or congestion from undertaking a car journey are greater than the costs of not undertaking the journey.

The Bureau's 'avoidable social cost' is illustrated in Figure 1 (BTRE 2007: Figure 2.37). The AC curve shows how the average cost paid by each (identical) driver for a typical trip varies with the number of trips taken at current road capacity. At low levels of traffic, they are at AC_F , costs per trip under free-flow conditions. Eventually, adding an additional car on the road slows down existing traffic, increasing the cost of travel for other drivers, an externality. The AC curve starts to slope up. The social marginal cost (MC) of an extra trip is the private cost (AC) plus this extra congestion cost imposed on other drivers; the MC curve lies above the AC curve when the AC curve slopes upwards.

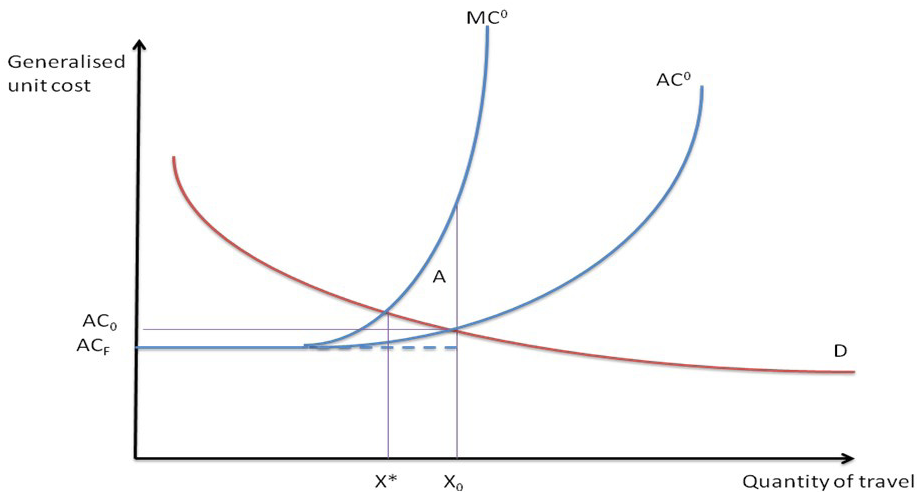


Figure 1: The costs of congestion

Source: BTRE 2007: Figure 2.37.

The optimal number of trips is X^* , where the benefit from an extra trip just equals its marginal social cost. When each driver decides whether to use the road, they compare the private costs and benefits of doing so and do not take account of the increase in cost that the journey imposes on others. The equilibrium number of quantity of travel is X_0 , where the total cost of travel is the rectangle $X_0^*AC_0$ or, equivalently, the area under the MC curve up to X_0 . Total congestion costs are that part of these areas above AC_F (that is, above the dotted line). The Bureau estimates the resulting deadweight loss from the excessive trips, X^*X_0 , which

impose social costs (including congestion costs imposed on others) greater than social benefits: triangular area A, which is about half the total congestion costs at X0 (p.78).

The authors estimate vehicle kilometres travelled in each of the eight capital cities and then estimate average speeds and the cost of delay. The costs are projected through to 2020 — by estimating the vehicle kilometres travelled in each city through to 2020 and applying the same methodology. Vehicle kilometres travelled in the eight metropolitan areas are projected to increase by 33.9 per cent over that period (Table 2.1, p.67) and costs by 116.8 per cent. Part of the growth in vehicle kilometres driven comes from the projected 16 per cent increase in the population of the capital cities (Table A.2, p.128). Per-head congestion costs increase by less (87 per cent = $2.168/1.16 - 1$).

The authors qualify the results, pointing out that they use ‘aggregate indicators of a city’s overall average traffic conditions’ (p.iii) rather than network models that attempt detailed simulations of traffic flows on a city’s road system. The report provides ‘order of magnitude evaluations’ (p.2).

The authors conduct sensitivity testing. Reasonable variations in parameter assumptions result in a range of estimated costs from \$5–15 billion in 2005, rising to \$10–30 billion in 2020. The wide spread in the estimates reflects the difficulty in calculating congestion costs and underlines the fact that the figures should be used with care. Yet the level of uncertainty surrounding the estimates is rarely communicated.

The authors recognise the figures are uncertain, but emphasise (p.125) their finding that costs will double over the 15 years to 2020, under the assumptions of the model that they have applied:

the principal finding of this study remains: that, in the absence of improved congestion management, rising traffic volumes in the Australian capitals are likely to lead to escalating congestion impacts, such that the net social costs of congestion over the next 15 years (under a business-as-usual scenario) are likely to at least double.

‘Prediction is very difficult, especially about the future’³

We are now almost halfway through the projection period. How have the numbers held up? In August 2011 the Bureau published revised estimates

3 Niels Bohr, Danish physicist (1885–1962).

of vehicle kilometres in Australia, derived from fuel sales data (BITRE 2011). These recent estimates of annual vehicle kilometres are significantly below the projections that underlie the Bureau's congestion cost estimates — 15 per cent lower in 2009–10 for cars and light commercials (Loader 2011). The projections assumed the shares of different transport modes in metropolitan trips would stay constant, city travel growth would equal population growth rates and that world oil prices would fall to nearly US\$50 a barrel by 2011 (2005 dollars) (Figure A.4 p.34). None of these has happened, and the global financial crisis reduced travel demand. Car passenger kilometres per capita peaked in 2004 for all cities and have been mostly in decline since then, and there was a mode shift towards mass transit, with passenger kilometres per capita rising significantly from 2004–05 to 2008–09, especially in Melbourne (Loader 2012, using data from the Bureau's Australian Infrastructure Yearbook). One analyst concludes: 'There is strong evidence that "business-as-usual" growth in vehicle kms is just not happening in Australian cities, and thus the 2007 forecast doubling of congestion costs by 2020 is very unlikely to play out' (Loader 2011).

The magic wand is not a policy instrument

At best, the Bureau's aggregate congestion-cost figures indicate the potential gains (if the model's assumptions hold true) from a costless, perfect pricing scheme, which sets price equal to marginal cost at all times and results in the optimal level of road use. It is an example of magic wand economics. It is the benefit from waving a magic wand and getting the optimal level of congestion. Unfortunately, magic wands are in short supply.

In practice, actual congestion pricing schemes are expensive, imperfect, and not able to capture the theoretical benefits identified. For example, charging on part of the road network increases congestion on uncharged substitute roads, offsetting the benefits from charging. The greater the marginal congestion costs on other roads and the greater the portion of drivers diverted off the priced road that move to other roads, the lower the optimal charge and the smaller the benefits.

Further, road pricing schemes are costly to set up and operate. The London Congestion Charge required start-up costs of £200 million in 2003 pounds (Santos and Shaffer 2004: 177). The total start-up cost of the Stockholm trial was 1.9 billion Swedish Kronor in 2006 (Eliasson 2008: 401), around A\$300 million at current exchange rates. In the Netherlands, the cost of implementing a national system of congestion charging was estimated in 2006 as €2.2–4.1 billion (2006 euros), with operational costs estimated to be €500–1100 million per annum (BITRE 2008: 43). Experience in Singapore, London and Stockholm suggests operating

costs eat up 15–30 per cent of revenue collected (International Transport Forum 2010: 9). It is an open issue whether road pricing schemes generate enough benefits to justify their enormous costs and overseas experience has shown they rarely produce a net community benefit. If it costs more to avoid the costs than to bear them, then they are not really avoidable social costs.

Justification requires rigorous case-by-case analysis and tailor-made strategies that are location and project specific. The optimal charging system would vary from city to city, determined by the topography of the city, the shape of the road network and the nature of the traffic flows.

For example, an earlier Bureau of Transport and Communication Economics report pointed out that Sydney does not appear to be a likely candidate for a cordon scheme since much of its congestion involves traffic not travelling through the CBD. Melbourne's different spatial form and travel behaviour mean that the pattern of congestion is markedly different, and tends to be concentrated on a small central area near the CBD, thus favouring cordon pricing (BTCE 1996: 74–5).

Although it is often claimed that the Bureau's measure of the deadweight loss from congestion is 'the cost that is relevant from the point of view of policy formulation' (Meyrick 2011: 109), it does not capture the benefits from congestion policies other than charging. For example, the net benefits from increases in road capacity and subsidies to public transport depend on the change in total congestion costs (which are real costs borne by drivers) — not just the change in the deadweight loss triangle (excessive costs).

'Avoidable social cost' estimates: Better is worse

Worse, a beneficial increase in road capacity may increase the Bureau's measure of congestion costs. This is illustrated in Figure 2 below. An increase in capacity shifts the average and marginal cost curves from AC0 and MC0 to AC1 and MC1, making them flatter (by reducing the effect of extra cars on travel times). The extra capacity shifts them down if it increases free-flow speeds. The deadweight loss with the new capacity is area B, which could easily be bigger than area A, depending on the shape of the cost and demand curves.

The cost paid by drivers falls from AC0 to AC1, giving a benefit to drivers (increased consumer surplus) equal to the shaded area (the gain from a reduction in travel time on existing trips plus the consumer surplus on the additional trips taken, the so-called induced traffic X0X1), and it is possible that will exceed the costs of the extra capacity. So a desirable capacity expansion could increase the BTRE's measure of the costs of congestion.

The Bureau assumes a constant elasticity of demand for travel of -1.2 (p.103). This elastic demand means that in the Bureau's model, a 1 per cent fall in AC increases traffic by more than 1 per cent, travel costs (AC x quantity of road use) increase, and so may the costs of excessive travel. If so, that means the Bureau's assumption of steadily increasing capacity may act to increase its congestion cost estimates rather than reduce them, as commonly assumed. An increase in demand will increase measured deadweight loss; an expansion in capacity may stimulate road use and increase deadweight loss further.

Some environmentalists claim that building more roads is not a sensible response to traffic congestion: having more roads simply encourages more cars and you are back where you started from. Richard Moe, head of the US National Trust for Historic Preservation, states: 'Building more roads to ease traffic is kind of like trying to cure obesity by loosening the belt' (cited in Ball 2004: 195). The above analysis shows that so long as the demand is not perfectly elastic, there is a benefit to drivers to be weighed against the costs of capacity expansion — despite inducing more traffic. The Henry Tax Review (2010: 53) states that 'the avoidable costs of urban congestion may grow to around \$20 billion in 2020. This cannot be reduced simply by building more city infrastructure, as most new road space induces new traffic.'

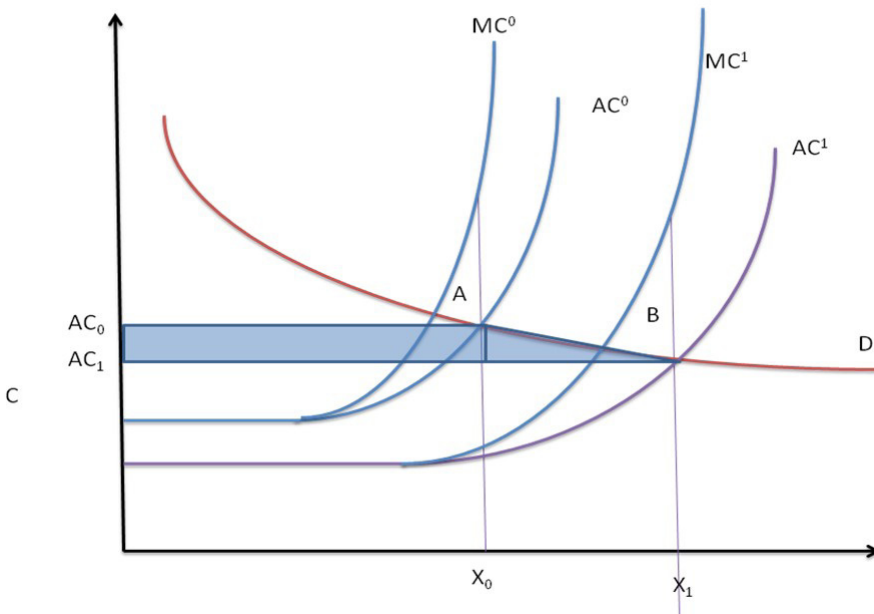


Figure 2: The effect of a capacity expansion

Source: Author's modelling.

Although more roads may indeed increase the deadweight loss from not pricing, increased capacity may produce a net benefit that needs to be compared with the net benefits of other policies.

The point is that because the BTCE measure of 'avoidable social cost' does not measure the benefits from road expansion it is useless for judging that way of dealing with congestion. It is a measure of the potential benefits from road pricing — which could rise or fall with increased capacity. An increase in the deadweight-loss triangle from A to B tells us there would be a greater welfare gain from introducing efficient pricing at the higher capacity.

The necessity for cost–benefit analysis

The public interest is more likely to be served if all options for reducing congestion are rigorously evaluated and judged, and provision and pricing decisions made, on the basis of efficiency-based cost–benefit analysis.

Congestion charging results in an efficiency gain if the revenue to road owners (which comes at the expense of motorists) exceeds the net loss to motorists. Revenue from congestion pricing needs to be spent wisely and not treated as some windfall. The efficiency gain is likely to be small relative to the gain in revenues. It does not take much by way of costs involved in developing and implementing a congestion charging system to eliminate any efficiency gains. Further, if some of those revenues are wasted, such as being spent on projects with costs greater than benefits, even a small proportion of waste could outweigh any efficiency gains from congestion charging.

In particular, it shouldn't be automatically assumed that the proceeds should be spent on public transport, as is done in most overseas schemes. Public transport can potentially play a significant role in the successful implementation of road pricing, especially as road pricing increases demand for alternative transport options. However, this role does not allow planners to abdicate responsibility for applying standard project evaluations to public transport developments. With roads properly priced, the efficiency case for subsidising public transport diminishes. Increased subsidies to public transport can therefore yield benefits less than their costs. Nor should the proceeds automatically be spent on building roads.

In the Bureau's model, congestion pricing must make drivers worse off since it works by raising the cost to drivers to get them off the road. Congestion charging is likely to be inequitable, because the net benefits of road pricing to a driver decline (become more negative) with his value of time, and value of time and income are positively correlated. The poor lose the most from road pricing.

Without rigorous project appraisal, the political process could produce a congestion charging scheme which is both inequitable and inefficient, lowering social welfare and reflecting badly on both the government that implemented it and on the idea of congestion charging. In fact, evaluations of actual road pricing schemes often find the costs to be greater than the benefits.

Economists should focus on designing efficient schemes which provide gains that can be used to compensate losers. Policymakers need to focus on providing more useful data: aggregate congestion-cost figures distract from the serious policy work required.

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